What is claimed is:

1. An improved MRI system having a compact magnet and an RF coil which accommodate a human extremity such as a heel and external reference materials to measure the proton density of bone marrow to quantify trabecular bone volume fraction.

2. An improved MRI system as in claim **1** wherein said RF coil is stored in an electromagnetically shielded box to eliminate the electromagnetic coupling between the RF coil and gradient coil.

3. An improved MRI system as in claim **2** wherein said RF probe box has an oval aperture to accommodate a human extremity such as a heel.

4. An improved MRI system as in claim **2** wherein a support pad for a heel and external reference materials is inserted into said RF probe open-bore to fix the heel and to acquire calibration image data at the same time.

5. An improved MRI system as in claim **4** wherein said external reference material is flexible and can be used to fix a heel and to improve the precision of measurement of the RF magnetic field.

6. An improved MRI system as in claim **1** wherein large flip angle spin-echo imaging sequences are used to shorten the repetition time of the sequences.

7. A method for quantifying proton densities in inhomogeneous static magnetic field, magnetic field gradients, and RF magnetic field, comprising the step of:

(a) measuring cross-sectional MR images of a human extremity such as a heel together with external reference materials with two spin-echo sequences in which the repetition time TR is long enough for signal saturation for the proton spins in the region of

interest and one spin-echo time is set as short as possible and the other spin-echo time is set longer than that of the shorter one by about 100ms to eliminate the J modulation effect on T_2 decay correction;

(b) dividing the image intensity of said MR image with the longer spin-echo time by that of said MR image with the shorter spin-echo time to calculate T_2 relaxation time and spin density distribution including the spatial variation function for the imaging area;

(c) correcting the T_2 decay by multiplying exponential function of the shorter spin-echo time divided by T_2, by said MR image with the shorter spin-echo time;

(d) measuring cross-sectional MR images of a reference material such as paramagnetic salt doped water at the position where the human extremity was placed together with said external reference materials with two spin-echo sequences in which the repetition time TR is long enough for signal saturation for the proton spins and one spin-echo time is set as short as possible and the other spin-echo time is set longer than that of the shorter one by about T_2 relaxation time of the protons of the reference material to optimize the T_2 decay correction;

(e) dividing the image intensity of said MR image of the reference material with the longer spin-echo time by that of said MR image of the reference material with the shorter spin-echo time to calculate T_2 relaxation time and the spatial variation function for imaging area;

(f) correcting the T_2 decay by multiplying exponential function of the shorter spin-echo time divided by T_2, by said MR image of

the reference material with the shorter spin-echo time; and

(g) dividing the T_2 corrected MR image calculated in (c) by the T_2 corrected MR image calculated in (f) to obtain the proton density of the human extremity such as a heel when the proton density of the reference material is defined as unity.

8. The method of claim **7**, wherein the image intensity calculations are performed using means over some regions of interests to improve the data fluctuation.

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